DOCUMENT RESUME

ED 448 208		TM 032 238
AUTHOR	Roberts, J. Kyle; Henson, Robin K.	
TITLE	Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST): A Proposal for a New Efficacy Instrument.	
PUB DATE	2000-11-16	
NOTE	27p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (28th, Bowling Green, KY, November 17-19, 2000).	
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150) -- Tests/Questionnaires (160)	
EDRS PRICE	MF01/PC02 Plus Postage.	
DESCRIPTORS	Elementary Education; Elementary School Teachers; Knowledge Level; *Measures (Individuals); *Science Teachers; *Self Efficacy; *Teaching Methods	
IDENTIFIERS	Confirmatory Factor Analysis	

ABSTRACT

This paper introduces a new self-efficacy instrument for science teachers and presents confirmatory factor analysis results for 247 elementary school teachers. Building on previous research on the Science Teaching Efficacy Belief Instrument (STEBI) (I. Riggs and L. Enochs, 1990), the new instrument, the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST), hypothesizes that science teacher self-efficacy exists in two constructs: teaching efficacy and knowledge efficacy. The second factor is based largely on the work of Lee Shulman. An appendix contains the SETAKIST instrument. (Contains 2 figures and 40 references.) (SLD)

TM

Running head: SETAKIST

Self-efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST): A Proposal for a New Efficacy Instrument

J. Kyle Roberts

Baylor College of Medicine

Robin K. Henson

University of North Texas

Paper Presented at the Annual Meeting of the Mid-South Educational Research Association, November 16, 2000, Bowling Green, KY. Correspondence concerning this manuscript should be sent to the first author at Medical Towers, 1709 Dryden, Suite 545, Houston, TX 77030.

Abstract

This paper proposes to introduce a new self-efficacy instrument with confirmatory factor analysis results from 247 elementary teachers. Building from previous research on the STEBI the new instrument (SETAKIST) hypothesizes that science-teacher self-efficacy exists in two constructs: teaching efficacy and knowledge efficacy. The second factor in this instrument is argued from and based largely on the work of Lee Shulman.

Self-efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST): A Proposal for a New Efficacy Instrument

Since the idea of self-efficacy was first developed in the late 1970's as part of social cognitive theory (Bandura, 1977), researchers have been utilizing this theoretical construct to try and explain differences in teacher practice and student achievement. One of the first mechanisms for measuring teacher self-efficacy was the Teacher Efficacy Scale, or TES (Gibson & Dembo, 1984). The TES was based on Bandura's idea that self-efficacy actually consisted of two constructs: self-efficacy and outcome expectancy. While the initial items used in the development of the TES were based on Rotter's (1966) locus of control theory, Gibson and Dembo (1984) argued that these items corresponded with Bandura's constructs of self-efficacy and outcome expectancy. Hence the TES was originally designed with 16 items that measured two latent constructs: personal self-efficacy and outcome expectancy (also called general teaching efficacy).

With the growing use of the TES and other related instruments, researchers began to notice that measurements of teacher self-efficacy had high correlations with teaching performance (Riggs et al., 1994), teachers' reported enjoyment of teaching (Watters & Ginns, 1995), time spent developing subject specific concepts in class (Riggs & Jusenthadas, 1993), and degree of risk taking (Ashton & Webb, 1986). Bandura (1982) also noted that highly efficacious people tend to show higher levels of effort and are resilient in continuing their efforts, even in adverse situations. Needless to say, researchers were thrilled with the utility of the TES for monitoring teacher efficacy factors, leading one researcher to label it a "standard" instrument for measuring teacher efficacy (Ross, 1994, p.382). Other related scales that precluded the TES included the Responsibility for Student Achievement (Guskey, 1981), the Teacher Locus of Control (Rose & Medway, 198[illegible]), and the Webb Scale (Ashton, Olejnik, Crocker, & McAuliffe, 1982).

Riggs and Enochs also worked to show that teacher efficacy was both a context and subject matter specific construct. In developing this theory (which is consistent with Bandura's (1977) formulations), they constructed the Science Teaching Efficacy Belief Instrument, or STEBI, and the Microcomputer Utilization in Teaching Efficacy Beliefs Instrument, or MUTEBI (Enochs, Riggs, & Ellis, 1993; Riggs & Enochs, 1990). Based on the two-factor form of the TES, the STEBI and MUTEBI consist of two dimensions, called personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE) for the STEBI and the self-efficacy (SE) and outcome expectancy (OE) for the MUTEBI.

Although long considered the standard for measuring self-efficacy, the TES has come under an increasing amount of fire. Researchers have argued that the second construct, outcome expectancy, actually measures external influences or external attributions for student success or failure (Coladarci & Fink, 1995; Guskey & Passaro, 1994; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Similarly, Roberts, Henson, Tharp, and Moreno (in review), while critiquing the STEBI, stated, "while the two-factor solution [PSTE and STOE] is very parsimonious, it brings to question the reliability of a solution that cannot explain more than 60% of the overall variance." As a result, Roberts et al. (in review) cautioned researchers against utilizing the outcome expectancy construct of the TES, STEBI, and MUTEBI. This caution is echoed by other researchers on grounds of poor construct validity (Coladarci & Fink, 1995; Guskey & Passaro, 1994; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998).

Henson, Bennett, Sienty, and Chambers (2000) also examined the factor structure of the TES with principal components analysis. Among their results, they argued for both deleting items 5, 12, 14, and 16 after consulting the orthogonally rotated factor pattern/structure matrix and for a three-factor solution after consulting the parallel analysis. Furthermore, the possibility of a three-factor solution is suggested by Guskey (1988) and Woolfolk and Hoy (1990).

Tschannen-Moran (2000), in response to the problems associated with the TES and other instruments, developed The Ohio State Teacher Efficacy Scale. In this paper, Tschannen-Moran argued for a one-factor solution for a 36-item instrument. Although the eigenvalues seem to also support a one-factor solution, the question arises again concerning the utility of an instrument that cannot explain at least 60% (original instrument explained 35.8%) of the variance in the inter-item matrix of associations.

Due to the problems associated with the previously mentioned instruments, the present study focused on developing an instrument that could address both the methodological and theoretical problems of efficacy instruments within the field of science education. The resulting instrument is the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST).

Methodology

Because of the previous problems with the outcome expectancy scale, we sought to re-develop this construct. The first construct, personal self-efficacy, was essentially left the same with a little refinement to improve data fit to the hypothesized model.

The Teaching Efficacy Construct

We originally hypothesized a two-construct method of measuring efficacy. The first of these constructs, teaching efficacy, was developed in a response to the growing body of literature that is calling for higher standards for teacher development before teachers enter the classroom (Bowles & Levin, 1968; Hanuschek, 1970; Kerr, 1983; Weaver, 1979). This construct is similar to the personal teaching efficacy constructs in both the TES and the STEBI. The personal efficacy construct is defined by questions 2, 4, 6, 8, 10, 12, 15, 16 on the SETAKIST. It was decided that this construct did not need much refining since previous studies have shown it to be relatively stable (Guskey, 1988; Roberts et al., in review; Woolfolk & Hoy, 1990).

The Knowledge Efficacy Construct

The second construct, knowledge efficacy, needs some elaboration. The idea for this construct is based largely on the work of Lee Shulman (1986) in the field of pedagogical content knowledge. Put simply, pedagogical content knowledge is concerned with the way that subject matter is transformed from the mind of the teacher into the substance of instruction (Shulman, 1986). This definition of pedagogical content knowledge attempts to extend the knowledge of a subject into the subject matter knowledge specific to the art of teaching that subject. In this article, Shulman quotes Father Walter Ong (1958) to suggest that content and pedagogy should be part of "one indistinguishable body of understanding" (p. 6).

The reason that this instrument includes both knowledge and instruction (pedagogy) constructs is because, as Shulman (1986) notes, "the person who presumes to teach subject matter to children must demonstrate knowledge of that subject matter as a prerequisite to teaching. Although knowledge of the theories and methods of teaching is important, it plays a decidedly secondary role in the qualifications of a teacher" (p. 5).

Identifying both of these constructs necessary for effective teaching is not an entirely new concept, however. Grossman, Wilson, and Shulman (1989) referred to the "content knowledge for teaching [and] substantative knowledge for teaching" (p. 27) as dimensions of subject matter for teaching. Grant (1988), Hashweh (1987), and Leinhardt and Smith (1985) also spent time researching the difference between expert and novice teachers and found that experienced teachers "know" their subject matter differently than less experienced teachers. Gudmundsdottir (1995) characterized the focus of this research and says, "What is implied . . . is that teachers' content knowledge has been transformed into something different from what it was before, a form that has practical application in teaching" (p. 28).

The development of this second construct was defined by questions 1, 3, 5, 7, 9, 11, 13, and 14 on the SETAKIST.

Sample

The sample for the piloting of this instrument was drawn from 274 science teachers from Texas and Washington, D.C. Each of these teachers were involved in training sessions with Baylor College of Medicine's (Houston, TX) Center for Educational Outreach. Number of years teaching experience ranged from one year to twenty-three years. All of these teachers were either science teachers or science specialists for elementary students in their respective schools.

Results

Confirmatory Factor Analysis of the Data

We chose confirmatory factor analysis (CFA) in this analysis over exploratory factor analysis (EFA) because a strong hypothesis was already developed before data investigation was conducted. In situations where researchers have developed theories, CFA is often regarded as a stronger alternative to EFA. Gorsuch noted, "whereas the former [EFA] simply finds those factors that best reproduce the variables under the maximum likelihood conditions, the latter [CFA] tests specific hypothesis regarding the nature of the factors" (1983, p. 129). Furthermore, Muliak (1998) gives a strong criticism of EFA and says, "the continued preoccupation in the exploratory factor analysis literature with the search for *optimal* methods of determining the number of factors, of determining the pattern coefficients, and of rotating the factors, in the general case, reveals the inductivist aims that many have to make this method find either optimal or incorrigible knowledge" (p. 265). In short, CFA is a theory testing procedure whereas EFA is a theory generating procedure (Stevens, 1996).

All data were input into AMOS 4.0 (Arbuckle, 1999) and run with the hypothesized model of two correlated factors defined in Figure 1. Fit indices and weights from the model can be seen in Table 1.

Insert Figure 1 and Table 1 about here

Results from the fit indices led us to accept the two-factor model as having relatively good data fit (Dickey, 1996; Roberts, 1999; Stevens, 1996). Although some of these indices are among the lower thresholds for accepting data fit, the robustness of fit across all indices suggest good data fit to the hypothesized model in Figure 1.

As a test of construct validity, three competing models were tested in addition to the originally hypothesized two-factor solution. The first of these models was a solution that hypothesized a single, general efficacy construct that explained the sixteen items. This model reflects the single factor structure of the Ohio State Teacher Efficacy Scale (Tschannen-Moran, 2000) noted above, except that the test items differ. The second model (see Figure 2) was a three-factor solution that was derived based on modification indices and an exploratory factor analysis principal components varimax rotated solution. Although the derivation of this three-factor model had no *a priori* reasoning, the model was tested in order to determine if adding the additional parameters and variables contributed more to data fit. We also tested a two-factor uncorrelated (latent variables) model. This model was tested because the latent variable correlation from the originally hypothesized model was relatively small.

Insert Figure 2 and Table 2 about here

As can be seen from Table 2, the two-factor solution has the best fit of the data among the four models. Although the three-factor solution has estimates that are close to the two-factor solution, the two-factor solution seems more plausible for reasons of parsimony.

Discussion

The results of the present study provide support for the hypothesis for this new two-factor structure of teacher efficacy. Although this hypothesis is a new development in the movement of defining teacher efficacy, data seem to suggest a strong support for this model.

Although the knowledge efficacy construct has not been explicitly addressed in the efficacy literature, we have linked the idea of pedagogical content knowledge to previous rigorous research in teacher development (Gudmundsdottir, 1995; Hashweh, 1987; Shulman, 1987). Based on this research, the data generated from the SETAKIST questionnaire support the continued development of this construct.

An important component of our model is the unification of the concepts of perceived teaching ability and perceived grasp of content knowledge. Historically, research in teacher efficacy has explicitly focused on teachers' beliefs in their ability to facilitate student learning. These measures concentrate on perceived teaching ability. However, the literature on teaching performance indicates that content knowledge is part and parcel with (and essentially is a prerequisite for) teaching ability. Therefore, measures and models of teacher efficacy should account for knowledge efficacy, or a teacher's confidence in his or her mastery of content knowledge. The present instrument is presented as one measure of this dynamic within the area of science education.

With the development of the STEBI, Riggs and Enochs (1990) said concerning the outcome expectancy scale that the "factor analysis clearly demonstrated that the scales measured two discrete and homogeneous constructs" (p. 633). Although this may be true, Roberts et al. (in review) have pointed out that it still makes little sense to interpret a model that cannot explain more than 60% of the item inter-correlations and has a CFI, NFI, and GFI of 0.855, 0.771, and 0.863 respectively, for the data in their sample. Accordingly, the current instrument represent an important advancement in the field in that it provides both theoretical rationale for the inclusion of knowledge efficacy and strong methodological support for the hypothesized structure via confirmatory factor analysis.

Although the SETAKIST does not provide the lock-key solutions for theoretical and psychometric problems with the TES and STEBI, it has begun to examine problems with these instruments and provide alternatives for researchers interested in the measurement of teacher efficacy. Future research on this instrument should focus on development of stronger construct validity by examining the correlation between scores on the SETAKIST and other teacher efficacy and knowledge instruments. Furthermore, models of teacher efficacy may consider the inclusion of content knowledge as part of the efficacy process. If teachers' beliefs in their ability to facilitate student learning are somewhat dependent on their confidence with the subject matter, then efficacy models that omit this element may be lacking. One recent model presented by Tschannen-Moran et al. (1998) proposed that teaching competence, or a teacher's perceive skills and abilities, is a predictive component of self-efficacy. However, this component does not explicitly address content knowledge. Future models of teacher efficacy should strive toward more comprehensive understanding of the complex variables that impact teacher self-efficacy.

References

Arbuckle, J. L. (1999). AMOS (Version 4.0). Chicago, IL: Smallwaters.

Ashton, P. T., Olejnik, S., Crocker, L., & McAuliffe, M. (1982). *Measurement problems in the study of teachers' sense of efficacy*. Paper presented at the annual meeting of the American Educational Research Association, New York, NY.

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement* (Vol. 3). New York, NY: Longman.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147.

Bowles, S., & Levin, H. (1968). The determinants of scholastic achievement: An appraisal of some recent findings. *Journal of Human Resources*, 3, 3-24.

Coladarci, T., & Fink, D. R. (1995). *Correlations among measures of teacher efficacy: Are the measuring the same thing?* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Dickey, D. (1996). Testing the fit of our models of psychological dynamics using confirmatory methods: An introductory primer. In B. Thompson (Ed.), *Advances in social* *science methodology* (Vol. 4, pp. 219-227). Greenwich, CT: JAI Press.

Enochs, L. G., Riggs, I. M., & Ellis, J. D. (1993). The development and partial validation of microcomputer utilization in teaching efficacy beliefs instrument in a science setting. *School Science and Mathematics, 93*(5), 257-263.

Gibson, S., & Dembo, M. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*, 569-582.

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Grant, G. (1988). *Teaching critical thinking*. New York, NY: Praeger.

Grossman, P. L., Wilson, S., & Shulman, L. S. (1989). Teachers of substance: Subject matter knowledge for teaching. In M. C. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 23-36). Oxford: Pergamon.

Gudmundsdottir, S. (1995). The narrative nature of pedagogical content knowledge. In H. McEwan & K. Egan (Eds.), *Narrative in teaching, learning, and research* (pp. 24-38). New York, NY: Teachers College Press.

Guskey, T. R. (1981). The relationship of affect toward teaching and teaching self-concept to responsibility for student achievement. *Journal of Social Studies Research, 5*(69-74).

Guskey, T. R. (1988). Teacher efficacy, self-concept, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education, 4*, 63-69.

Guskey, T. R., & Passaro, P. D. (1994). Teacher efficacy: A construct validation. *American Educational Research Journal, 31*, 627-643.

Hanuschek, E. (1970). The production of education, teacher quality, and efficiency, *Do teachers make a difference* (Vol. DHEW OE-58042). Washington, D. C.: U.S. Government Printing Office.

Hashweh, M. (1987). Effect of subject matter knowledge in teaching of biology and physics. *Teaching and Teacher Education, 3*(2), 109-120.

Henson, R. K., Bennett, D. T., Sienty, S. F., & Chambers, S. M. (2000). *The relationship between means-end task analysis and context specific global self-efficacy in emergency certification teachers: Exploring a new model of teacher efficacy*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Kerr, D. H. (1983). Teaching competence and teacher education in the United States. In L. S. Shulman & G. Sykes (Eds.), *Handbook of teaching and policy* (pp. 126-149). New York, NY: Longman.

Leinhardt, G., & Smith, D. (1985). Expertise in mathematics instruction: Subject matter knowledge. *Journal of Educational Psychology, 77*(3), 247-271.

Muliak, S. A. (1998). Confirmatory factor analysis. In R. B. Cattell & J. R. Nesselroade (Eds.), *Handbook of multivariate experimental psychology*. New York, NY: McGraw-Hill.

Ong, W. J. (1958). *Ramus, method and the decay of dialogue.* Cambridge, MA: Harvard University Press.

Riggs, I. M., Diaz, E., Riggs, M., Jusenthadas, J., Brasch, K., Torner, J., Shamansky, L., Crowell, S., & Pelletier, A. (1994). *Impacting elementary science teachers' beliefs and performance through teacher enhancement for science instruction in diverse settings*. Paper presented at the annual conference National Association for Research in Science Teaching, Anaheim, CA.

Riggs, I. M., & Enochs, L. G. (1990). Toward the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education, 74*, 625-638.

Riggs, I. M., & Jusenthadas, J. (1993). *Preparing elementary teacher for effective science teaching in diverse settings*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Atlanta, GA.

Roberts, J. K. (1999). *Basic concepts of confirmatory factor analysis.* Paper presented at the annual meeting of the Southwest Educational Research Association, San Antonio, TX.

(ERIC Document Reproduction Service No. ED 427 091)

Roberts, J. K., Henson, R. K., Tharp, B. T., & Moreno, N. P. (in review). An examination of change in teacher self-efficacy beliefs in science education based on the duration of inservice activities. *Journal of Science Teacher Education*.

Rose, J. S., & Medway, F. J. (1981). Measurement of teachers' beliefs in their control over student outcome. *Journal of Educational Research, 74*, 185-190.

Ross, J. A. (1994). The impact of an inservice to promote cooperative learning on the stability of teacher efficacy. *Teaching and Teacher Education, 10*(1), 381-394.

Rotter, J. B. (1966). Generalized expectancies for interna versus external control of reinforcement. *Psychological Monographs, 80*, 1-28.

Shulman, L. S. (1986). Those who understand: Knowledge and growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Stevens, J. (1996). *Applied multivariate statistics for the social sciences* (3rd ed.). Mahwah, NJ: Erlbaum.

Tschannen-Moran, M. (2000). *The development of a new measure of teacher efficacy.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Tschannen-Moran, M., Woolfolk Hoy, A., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research, 68*, 202-248.

Watters, J. J., & Ginns, I. S. (1995). *Origins of and changes in preservice teachers' science teaching efficacy.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA.

Weaver, W. T. (1979). In search of quality: The need for talent in teaching. *Phi Delta Kappan, 61*(1), 29-32, 46.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of Educational Psychology, 82*, 81-91.

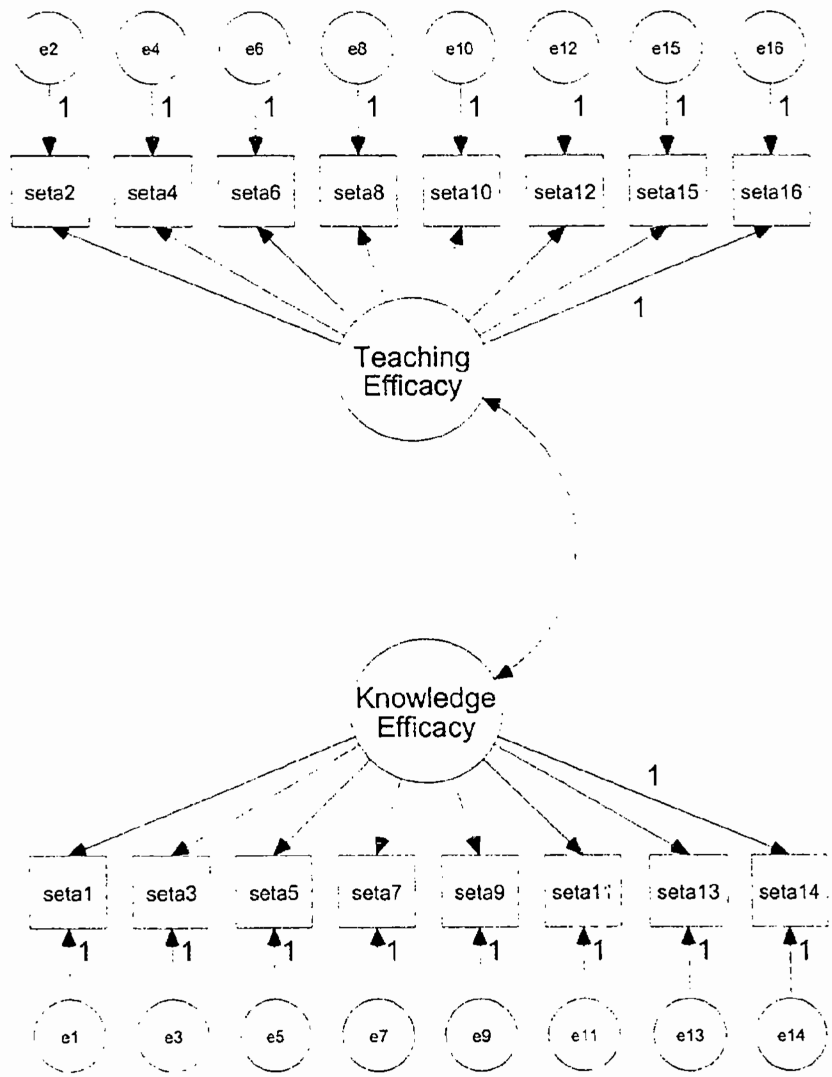

Figure 1

CFA model for two-factor solution of the data.

Table 1

Fit indices and model identification for the two-factor model

Variable	Value (standard error)
Regression Weights	
λ_{TE} - seta2	1.105 (.137)
λ_{TE} - seta4	1.140 (.148)
λ_{TE} - seta6	1.438 (.164)
λ_{TE} - seta8	1.144 (.136)
λ_{TE} - seta10	0.996 (.121)
λ_{TE} - seta12	0.923 (.122)
λ_{TE} - seta15	0.867 (.137)
λ_{TE} - seta16	1.000
λ_{KE} - seta1	0.417 (.086)
λ_{KE} - seta3	0.856 (.099)
λ_{KE} - seta5	0.862 (.129)
λ_{KE} - seta7	0.847 (.106)
λ_{KE} - seta8	1.253 (.139)
λ_{KE} - seta11	0.910 (.110)
λ_{KE} - seta13	1.393 (.135)
λ_{KE} - seta14	1.000
Covariance	
S_{TE-KE}	0.211 (.037)
Degrees of Freedom	103
Fit Indices	
Chi-square	192.957
CFI	.937
NFI	.876
TLI	.927
GFI	.917
RMSEA	.057

Note. TE is the Teaching Efficacy Scale, and KE is the Knowledge Efficacy Scale

Table 2

Fit indices across all three models

	Fit Index						
Model	χ^2	df	CFI	NFI	TLI	GFI	RMSEA
One-factor	393.154	104	.798	.746	.767	.802	.101
Two-factor	192.957	103	.937	.876	.927	.917	.057
Two-factor uncorrelated	297.793	104	.865	.808	.844	.887	.083
Three-factor	213.570	101	.921	.862	.906	.909	.064

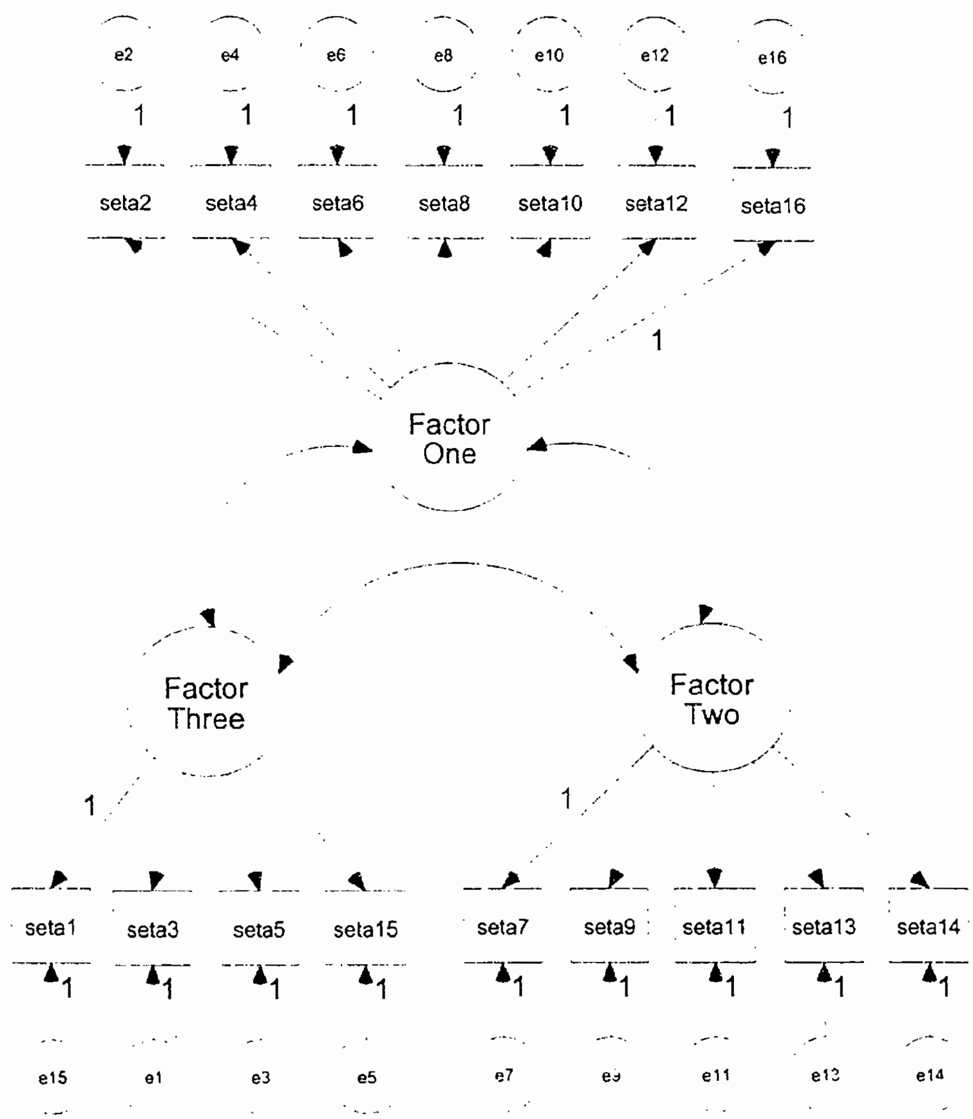

Figure 2

Hypothetical three-factor solution of the data.

Appendix A

SETAKIST form

Name ______________________ Date ____________

SETAKIST

Please indicate the degree to which you agree or disagree with each of the following statements by circling the appropriate number to the right of each statement.

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. When teaching science, I usually welcome student questions.	1	2	3	4	5
2. I do not feel I have the necessary skills to teach science.	1	2	3	4	5
3. I am typically able to answer students' science questions.	1	2	3	4	5
4. Given a choice, I would not invite the principal to evaluate my science teaching.	1	2	3	4	5
5. I feel comfortable improvising during science lab experiments.	1	2	3	4	5
6. Even when I try very hard, I do not teach science as well as I teach most other subjects.	1	2	3	4	5
7. After I have taught a science concept once, I feel confident teaching it again.	1	2	3	4	5
8. I find science a difficult topic to teach.	1	2	3	4	5
9. I know the steps necessary to teach science concepts effectively.	1	2	3	4	5
10. I find it difficult to explain to students why science experiments work.	1	2	3	4	5
11. I am continually finding better ways to teach science.	1	2	3	4	5
12. I generally teach science ineffectively.	1	2	3	4	5
13. I understand science concepts well enough to teach science effectively.	1	2	3	4	5
14. I know how to make students interested in science.	1	2	3	4	5
15. I feel anxious when teaching science content that I have not taught before.	1	2	3	4	5
16. I wish I had a better understanding of the science concepts I teach.	1	2	3	4	5